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HYDRAULICS

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Abstract

Full Text

HYDRAULICS

A. Kh. Mirzajanzade, M. A. Huseynzade, A. Sh. Asadov, G. M. Iskenderov

ON THE LAW OF GAS FILTRATION IN A POROUS MEDIUM

(Presented by Academician L. I. Sedov on 10 VI 1968)

In recent years, in the analysis and design of gas fields, the following dependence has been widely used, i.e. (⁀1)

$$\Delta p^2 = AQ + BQ^2, \qquad \Delta p^2 = P_1^2 - P_2^2, \tag{1}$$

where P_1 is the reservoir pressure; P_2 is the bottom-hole pressure; Q is the volumetric production rate.

Steady-state filtration of gas in a porous medium is described by equation (1), which in the coordinates $\Delta p^2/Q$ and Q represents a straight line.

In the present note we set forth the results of experimental studies of gas filtration, taking into account the presence of clay in the formation.*

The scheme of the apparatus for carrying out the experiments is shown in Fig. 1.

The procedure for conducting the experiments is as follows: after being filled with the tested porous medium, the column is connected from below to a container, which in turn is connected to a high-pressure cylinder. Gas or air is passed through the porous medium in a volume exceeding the pore volume by a factor of 286. At each regime, more than 100 pore volumes were passed through the porous medium. The porous medium consists of quartz sand and a mixture of it with clay.

In the experiments, air and dry gas taken from a well of the Zira field are used as the filtering phase.

From the experimental data it follows that, during filtration of both air and gas through a porous medium composed of quartz sand with a permeability of 20 darcies, the dependence between Δp^2 and Q obeys a linear law of filtration (curves 1 in Fig. 2).

With the addition of clay to the quartz sand, the indicated dependence is nonlinear and consists of two characteristic sections; moreover, with increasing clay content in the sand, the characteristic sections change.

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Fig. 1. Schematic of the apparatus. 1 —high-pressure cylinder, 2 —reducer, 3 —container, 4 —experimental column with porous medium, 5 —gas meter, and 6 —manometer

Figure 1: Fig. 1. Schematic of the apparatus. 1 —high-pressure cylinder, 2 —reducer, 3 —container, 4 —experimental column with porous medium, 5 —gas meter, and 6 —manometer

Fig. 2

Figure 2: Fig. 2

From the curves in Fig. 2 it is seen that, at a fixed value of Δp^2, the volumetric production rate of gas is greater than the volumetric production rate of air. This can be explained by interaction between the filtering phases and the clay, in particular by a sorption effect.

Fig. 1. Schematic of the apparatus.
1 —high-pressure cylinder, 2 —reducer, 3 —container, 4 —experimental column with porous medium, 5 —gas meter, and 6 —manometer.

* D. M. Dzhabarov took part in the experiments.

Fig. 2. Dependence between Δp^2 and Q during filtration of air (a) and gas (b) without clay (1) and with clay additions: 15% (2), 20% (3), 25% (4), 30% (5), 35% (6), 40% (7)

Therefore, one of the probable causes of the violation of the linear dependence between Δp^2 and Q is the influence of clays.

Azerbaijan Institute of Oil and Chemistry
named after M. Azizbekov

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Note: Figure translations are in progress. See original paper for figures.

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